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ABSTRACT

This report presents selected results concerning energy questions used to measure science achievement in the National Assessment of Educational Progress (NAEP), a nationwide survey of educational attainments of a sample of 9-year-olds, 13-year-olds, 17-year-olds, and adults aged 26-35. Data and graphs are presented concerning the performances on energy questions according to age level and type of question. (MH)

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SELECTED RESULTS FROM THE NATIONAL ASSESSMENTS OF SCIENCE: ENERGY QUESTIONS

2

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NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS
A Project of the Education Commission of the States

Arch A. Moore, Jr., Governor of West Virginia, Chairman, Education Commission of the States
Wendell H. Pierce, Executive Director, Education Commission of the States
J. Stanley Ahmann, Director, National Assessment

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NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

SELECTED RESULTS FROM THE NATIONAL ASSESSMENTS OF SCIENCE: Energy Questions

Science Report No. 04-S-01

May 1975

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NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

J. Stanley Ahmann
Director

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Associate Director

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FOREWORD

The National Assessment of Educational Progress (NAEP) is an information-gathering project which surveys the educational attainments of 9-year-olds, 13-year-olds, 17-year-olds and adults (ages 26—35) in 10 learning areas: art, career and occupational development, citizenship, literature, mathematics, music, reading, science, social studies and writing. At least one area is assessed every year, and all areas are periodically reassessed in order to measure educational progress. Each assessment is the product of several years work by a great many educators, scholars and lay persons from all over the country. Initially, these people design objectives for each area, proposing general goals which they feel Americans should be achieving in the course of their education. These goals are reviewed by more people and then passed along to developers of tests, whose task it is to create measurement tools appropriate to the objectives.

When the exercises prepared by the test developers have passed extensive reviews by subject-matter specialists and measurement experts, they are administered to probability samples of various populations. The people who comprise those samples are chosen in such a way that the results of their assessment can be generalized to an entire national population. That is, on the basis of the performance of about 2,500 9-year-olds on a given exercise, we can generalize about the probable performance of all 9-year-olds in the nation. Approximately 100,000 persons participate annually.

After assessment data have been collected, scored and analyzed, National Assessment publishes reports to present the results as accurately as possible. Not all exercise results are released for publication. Because NAEP will administer some of the same exercises again in the future to determine whether the performance level of Americans has improved or declined, it is essential that they be kept secret in order to preserve the integrity of the study. If the unreleased exercises can be discussed without revealing their content, they are examined. However, the discussion is much less detailed than it is for the released exercises.

The National Assessment of Educational Progress also publishes a *General Information Yearbook* which describes all major aspects of the assessment process. This volume defines the categories by which results are reported and elaborates on the scientific procedures utilized. The reader who desires more detailed information about how National Assessment defines its groups, prepares and scores its exercises, designs its sample and analyzes and reports its results should consult *General Information Yearbook*, *Report 03/04-GIY* which is available, as are all Assessment reports, through the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

PREFACE

When the United States Office of Education was founded in 1867, one charge set before its commissioner was to determine the nation's progress in education. Only recently has that century-old charge been addressed in a systematic way. It is being done by the National Assessment of Educational Progress (NAEP).

Each year since 1969 NAEP has gathered census-like information about levels of educational achievement across the country and reported its findings to the nation. During the first five years of its endeavors, National Assessment has interviewed and tested more than 400,000 representative young Americans. Baseline data on the achievement levels of young Americans in eight learning areas—science, social studies, music, literature, reading, writing, mathematics and citizenship—have been collected and reported.

This volume, *Selected Results From the National Assessments of Science: Energy Questions*, discusses selected questions of current concern. It represents a small portion of the information National Assessment has gathered. Future reports will provide more complete documentation and discussion of these and other results.

INTRODUCTION

The National Assessment of Educational Progress (NAEP) has now completed two major assessments of science. The first took place in the 1969—70 school year, and the second occurred in the 1972—73 school year. In these assessments over 400 questions were asked of 9-year-olds, 13-year-olds, 17-year-olds and young adults ages 26—35. Approximately one half of the questions asked in 1969—70 were asked again in 1972—73. Although no one age level was asked all of these questions, each was asked questions in a wide variety of topics based on four generally agreed-upon educational objectives in science. These objectives are that Americans should: (1) know some fundamental facts and principles of science, (2) possess some abilities and skills needed to engage in the process of science, (3) understand the investigative nature of science and (4) have some attitudes about science and appreciate its role in the culture.

Based on the results of its surveys, National Assessment has already reported a general decline in science achievement among American students between 1969 and 1973.[1] Numerous NAEP science questions asked in these surveys shed light on present national issues, which are topics of public concern and debate. Among the most publicized and perhaps the most serious is the issue of energy.

Although the National Assessment science surveys did not specifically address the energy issue, some of the questions asked are indicators of the knowledge base (both practical and theoretical) and the attitudes that young Americans had as the nation unwittingly moved toward the energy crisis. The data we have collected on these items should stimulate educators, politicians and researchers into further discussions about the level of public awareness on energy matters and the ability of the public to understand critical energy issues. If we are to solve our energy problems, the public must be able to make intelligent energy decisions.

The questions that follow represent items on which we can report changes as well as items that were asked for the first time in 1972—73. The questions are basic, yet the results are often surprising.

Reporting Variables

The National Assessment of Educational Progress (NAEP), unlike most testing programs, does not report scores for individuals.[2] Rather, it reports how defined *groups* of individuals respond to certain exercises. The groups are characterized by age, sex, race, region of the country, level of parental education and size and type of community (STOC).

The groups discussed in this capsule description are defined as follows.[3]

[1] A summary of these changes can be found in *National Assessments of Science, 1969 and 1973: A Capsule Description of Changes in Science Achievement, Science Report 04-S-00* (Washington, D.C.: Government Printing Office, 1975).

[2] More detailed information on the methodology employed by NAEP can be found in the *General Information Yearbook, Report 03/04-GIY* (Washington, D.C.: Government Printing Office, 1974). Specific chapters on sampling, objectives and exercise development, administration, data processing and analysis procedures can be found in this volume.

[3] Some group results are not discussed in this capsule description. Data are also collected for respondents who are neither black nor white within the variable color; for the highest level of parental education attained by either of a respondent's parents from no high school through post high school; and for medium cities, small places and urban fringe within the variable size and type of community. These groups will be discussed in later reports.

Region

The students have been divided into four groups, each representing a region of the country—Southeast, West, Central and Northeast—as shown in the following map.

Sex

Results are presented separately for males and for females.

Color

Results are presented for blacks and whites.

Size and Type of Community (STOC)

The groups within this variable are defined by the size of the community in which a student's school is located and an occupational profile of the area the school serves.

Low metro. People (about 10% at each age level) in this group attend schools serving areas in which a high proportion of the residents are on welfare or not regularly employed; these schools are in cities with populations greater than 150,000.

Extreme rural. Students (about 10% at each age level) in this group attend schools in a community where most residents are farmers or farm workers, and the population is less than 3,500.

High metro. Individuals (about 10% at each age level) in this group attend schools within the city limits or residential area served by a city with a population greater than 150,000; many residents of the area served by the school are professional or managerial personnel.

Main big city. These are students (about 11% at each age level) attending schools in a big city (population greater than 200,000) who are not included in either the low metro or high metro groups.

SELECTED ENERGY QUESTIONS

KEY

The following abbreviations are used on the first four exhibits in this section:

Nat — National

C — Central
NE — Northeast
SE — Southeast
W — West

F — Female
M — Male

B — Black
W — White

ER — Extreme rural
HM — High metro
LM — Low metro
MBC — Main big city

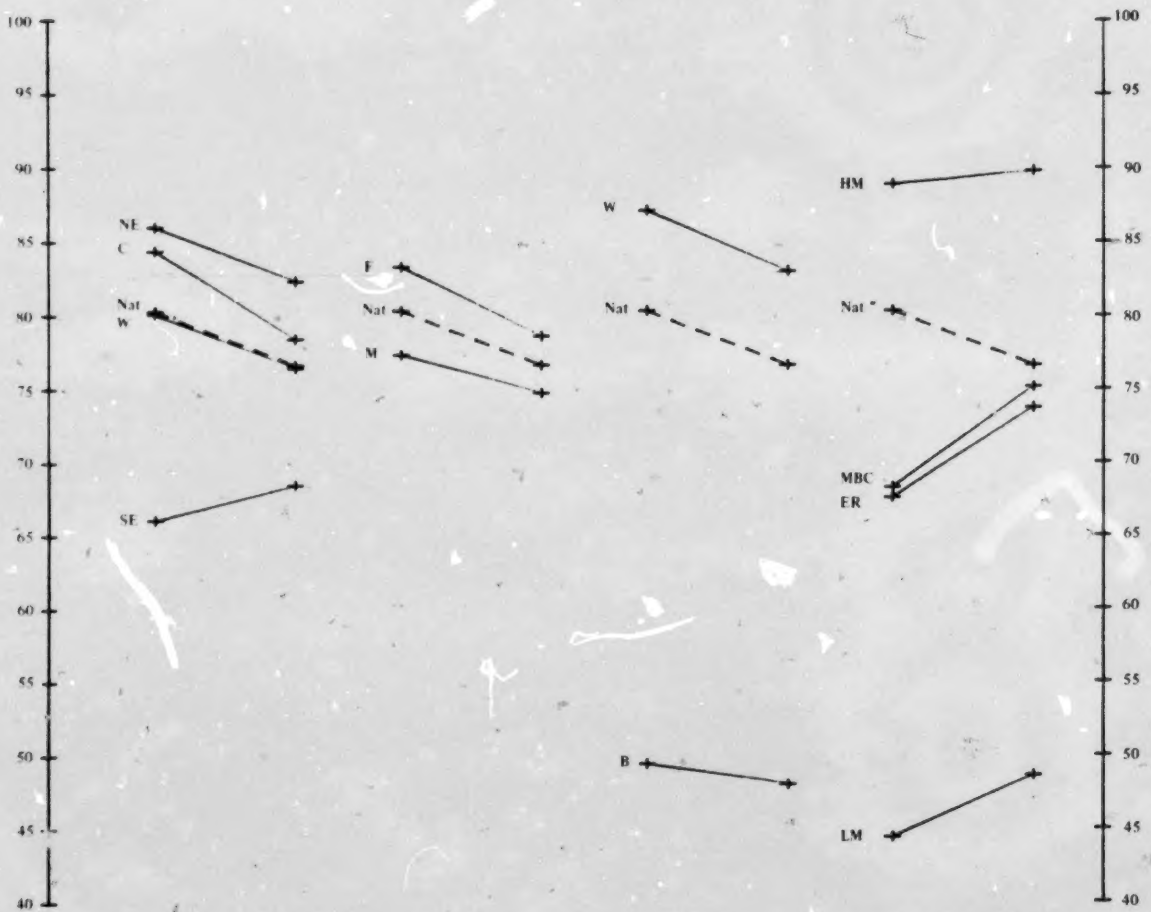
Do 9-Year-Olds Have a Fundamental Grasp of the Uses of Electricity?

Electricity can be used for all of the following EXCEPT

- ● taking walks.
- ○ cooking food.
- ○ heating homes.
- ○ lighting rooms.
- ○ I don't know.

In the 1970 National Assessment survey, 80% of the 9-year-olds selected the correct response to this question. In 1973, 77%, or 3% fewer 9-year-olds, could do so. Most of the groups measured by National Assessment also showed declining performance between 1970 and 1973. However, southeasterners, low metropolitan, main big city and extreme rural 9-year-olds all showed rather large gains on this question.

Selected Group Results, Electricity Question, 1970 and 1973*



*Three size and type of community (STOC) groups not shown in the illustration above—small places, medium cities and urban fringe—all showed large drops in performance between 1970 and 1973. This accounts for the fact that although the nation went down, all the groups shown exhibited gains.

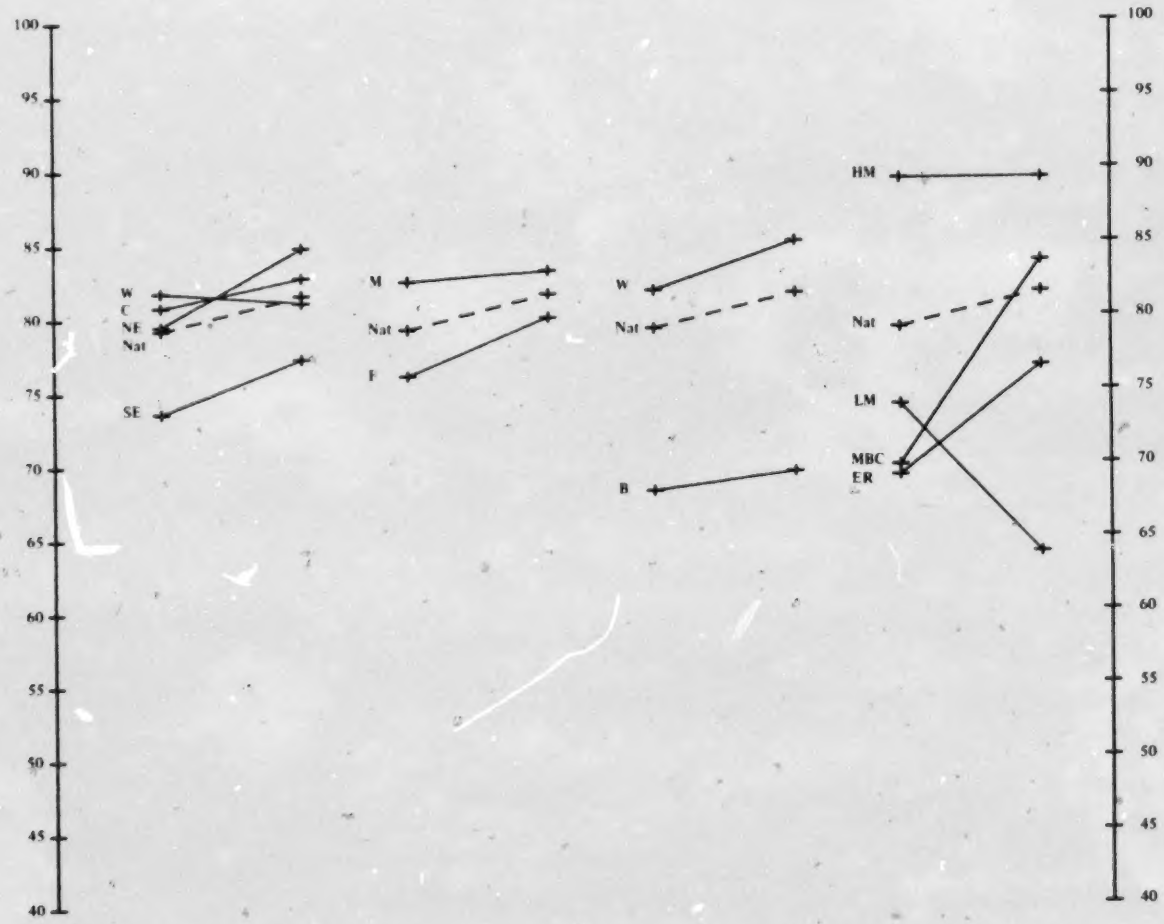
Do 13-Year-Olds Have a Basic Understanding of the Needs for Energy?

What is needed to move cars, heat hamburgers, and light rooms?

- ○ Conservation
- ○ Efficiency
- ● Energy
- ○ Friction
- ○ Magnetism
- ○ I don't know.

Seventy-nine percent of the 13-year-olds selected the correct answer in 1969. In 1972, the percentage was 82%—that is, 3% more knew the correct response. Notable among the groups that showed declines were the low metropolitan and western 13-year-olds. The main big city and extreme rural groups showed the most dramatic gains.

Selected Group Results, Energy Question, 1969 and 1972



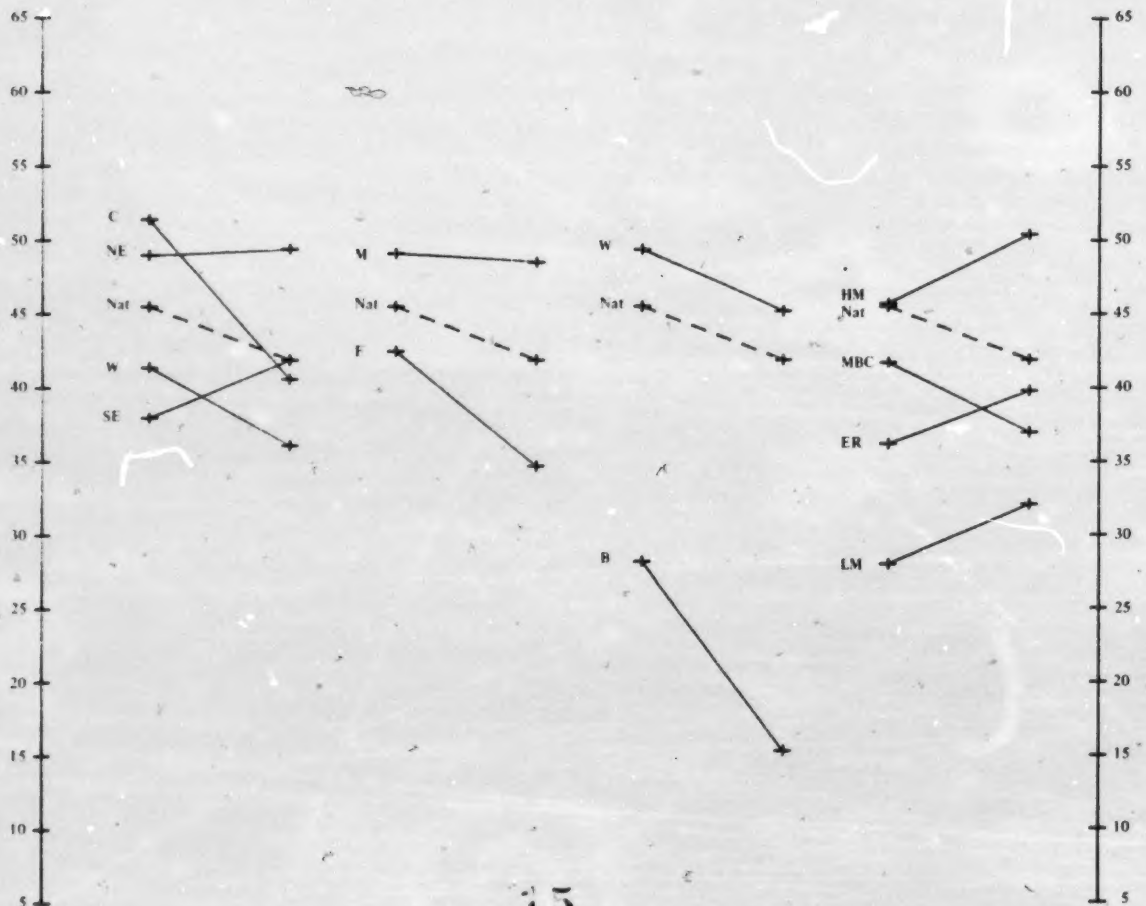
Do 13-Year-Olds Know How Electric Power Is Sold?

What does an electric power company sell in units of kilowatt-hours?

- ○ Atoms
- ○ Electrons
- ● Energy
- ○ Radiation
- ○ Time
- ○ I don't know.

In 1969, 46% of the 13-year-olds chose the correct response to this question. In 1972, only 42% of this age level did so. This represents 4% fewer 13-year-olds across the nation who knew the correct response. Central, female and black 13-year-olds showed the most dramatic declines on this question. Southeastern, extreme rural, low metro and high metro groups showed the greatest gains.

Selected Group Results, Power Company Question, 1969 and 1972



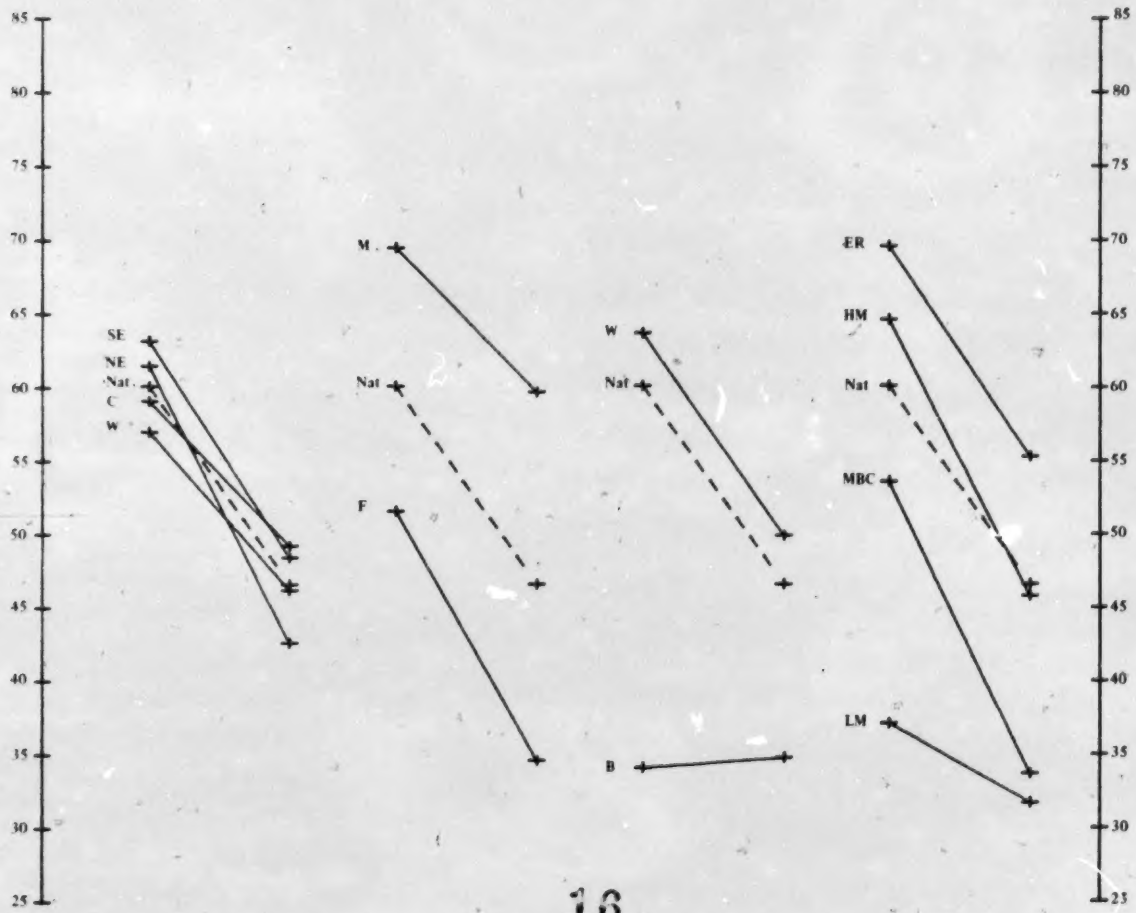
Do 17-Year-Olds Recognize a Basic Component in the Chain Between Electric Power and Their Use of It?

What device changes the voltage of an electric power supply?

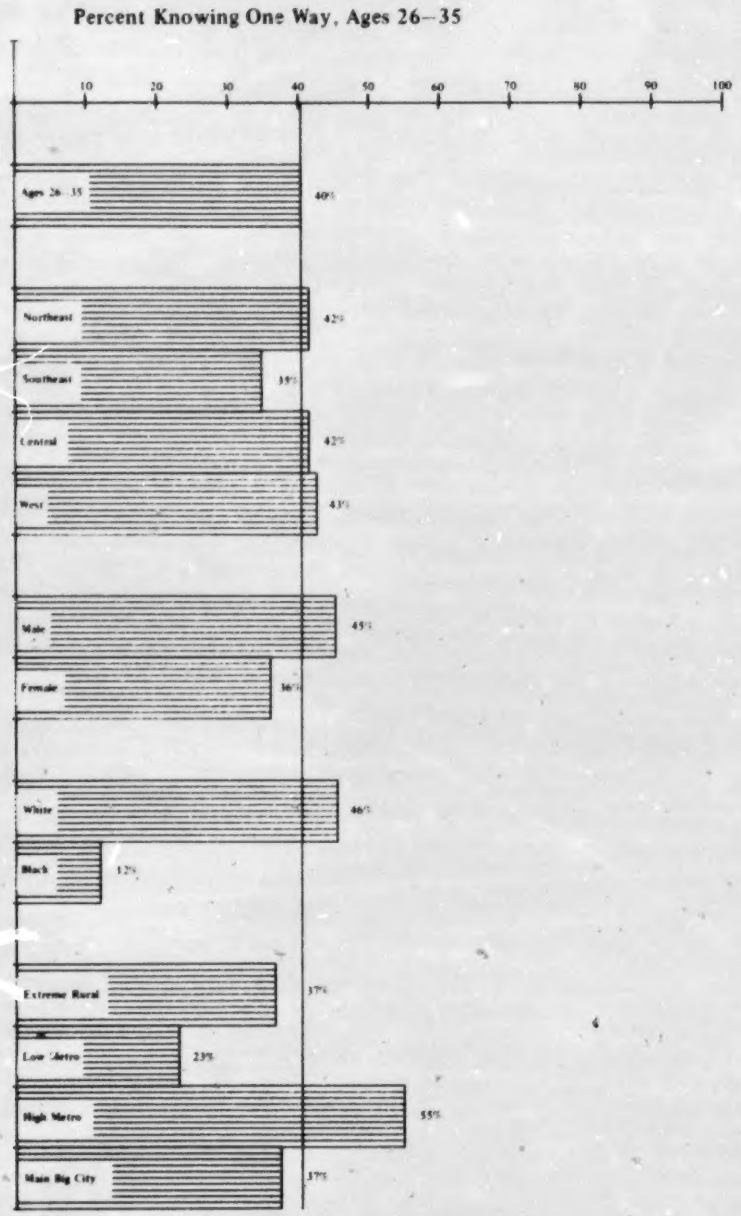
- ○ Alternator
- ○ Battery
- ○ Rectifier
- ● Transformer
- ○ I don't know.

When asked this question in 1969, 60% of the 17-year-olds chose the correct answer. In 1973 only 47% of the nation's 17-year-olds did so. This question was correctly answered by 13% fewer 17-year-olds in 1973. This represents a dramatic national decline. Among selected groups the declines were just as dramatic. Black 17-year-olds went against the national trend and showed slight gains.

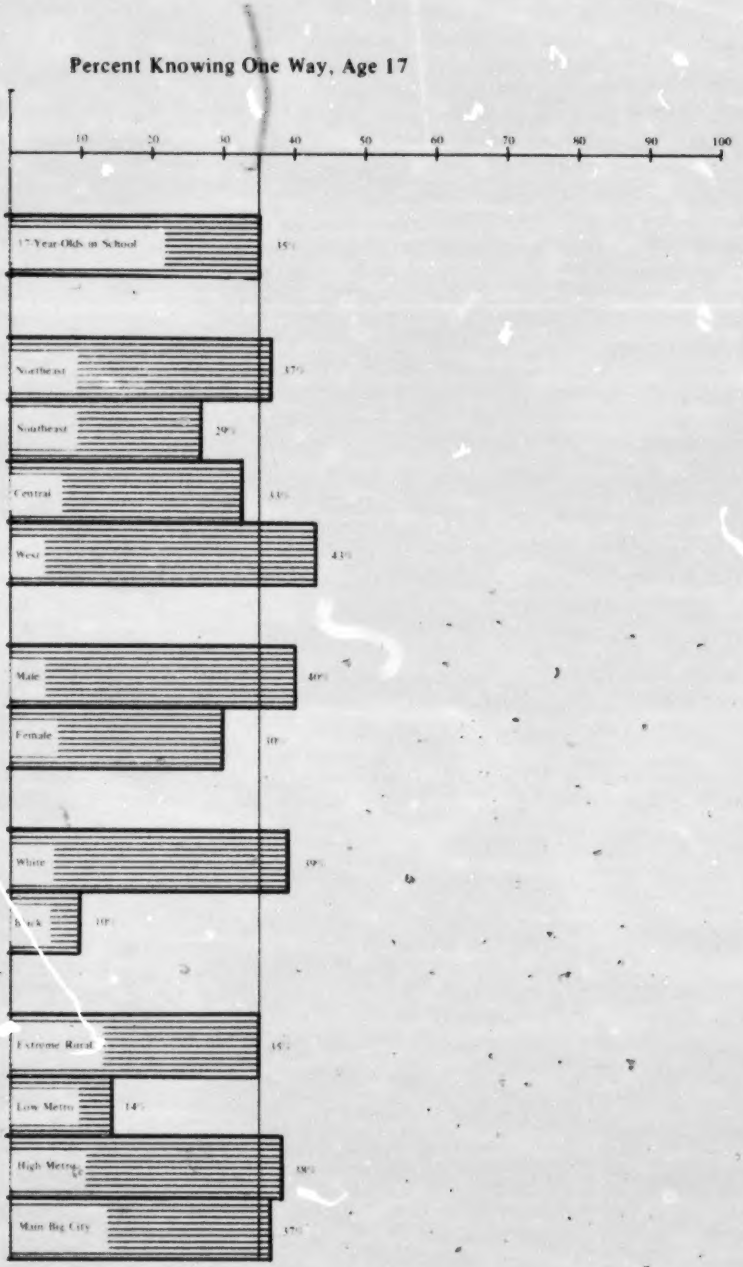
Selected Group Results, Transformer Question, 1969 and 1973



Do Young Americans Know a Way to Test Whether Premium Gasoline Should Be Used in a Second-Hand Automobile?



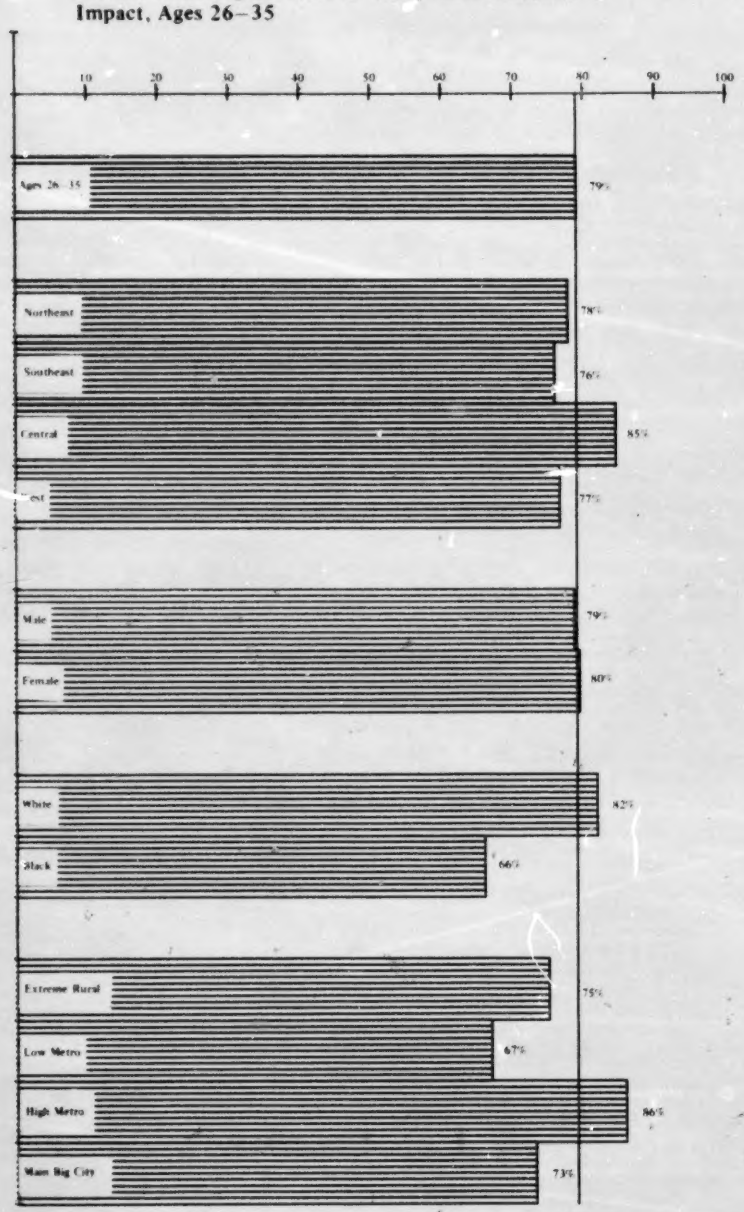
With the price of gasoline soaring, and little hope for relief in the future, the question of whether people know when to use regular or premium gas takes on economic significance. Surprisingly few (40%) adults could describe a simple test to determine the type of gasoline to use. Among the acceptable responses were answers categorized as checking the compression ratio of the engine, checking the general performance or mileage and checking the engine characteristics. Most disturbing is the fact that Americans who can least afford to make the wrong decision, the urban poor, had the lowest response levels. Only 12% of the blacks and 23% of adults in low metropolitan areas could describe one test.



Approximately one out of three 17-year-olds in school knew one way to test a used car in order to determine the type of gasoline to buy. As was the case among the young adults, more males than females knew a test. Seventeen-year-olds who were black or lived in low metropolitan areas scored particularly low on this question in 1973.

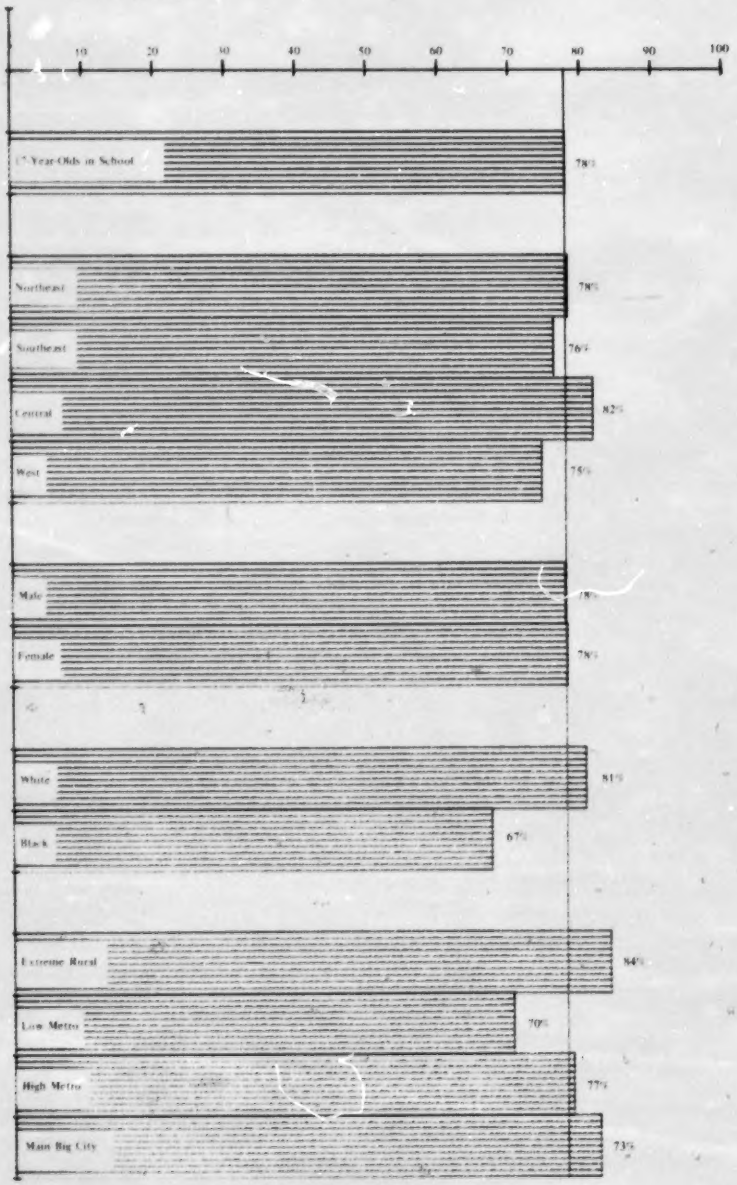
The Environmental Impact of New Energy Supplies: Do Young Americans Care?

Percent Realizing the Need to Study Environmental Impact, Ages 26–35



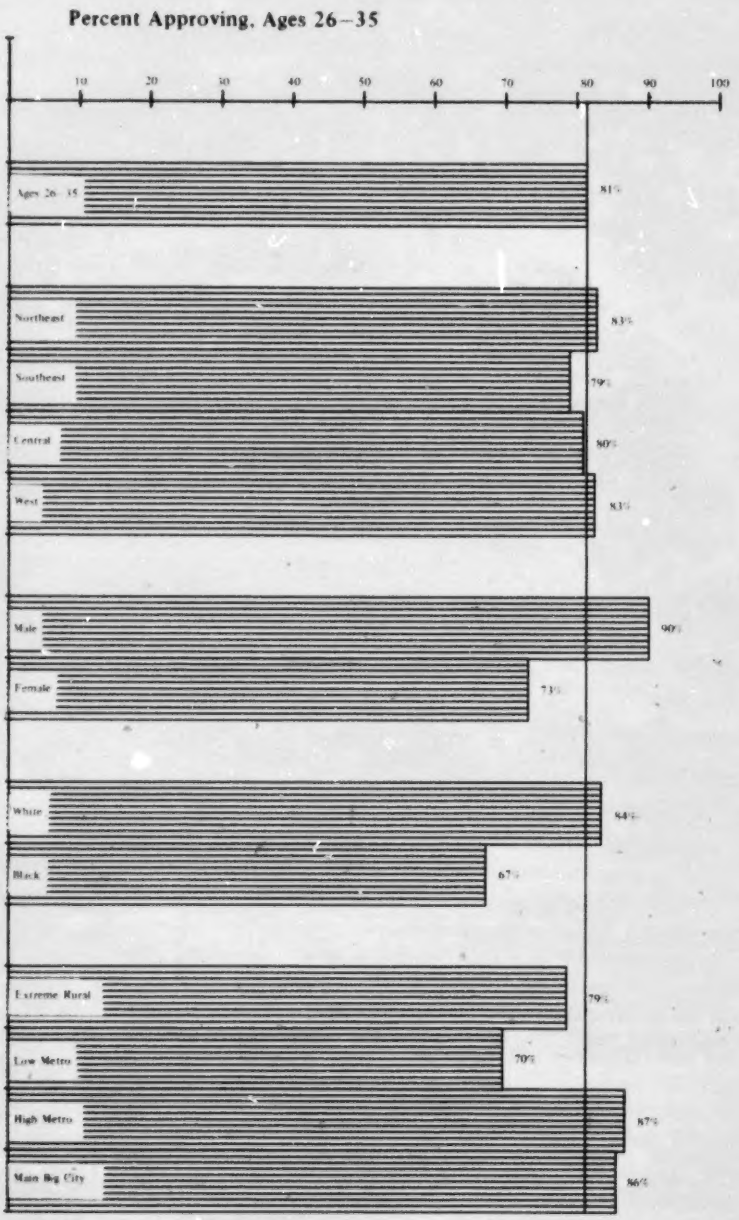
A large majority of young adults realized the need to study the environmental impact that a new energy plant would have on their community. This was before the energy crunch became a public issue, however. It should be very interesting to watch for indications of changing attitudes in this area. In general, the responses of specific subpopulations were consistent with the nation as a whole.

Percent Realizing the Need to Study Environmental Impact, Age 17

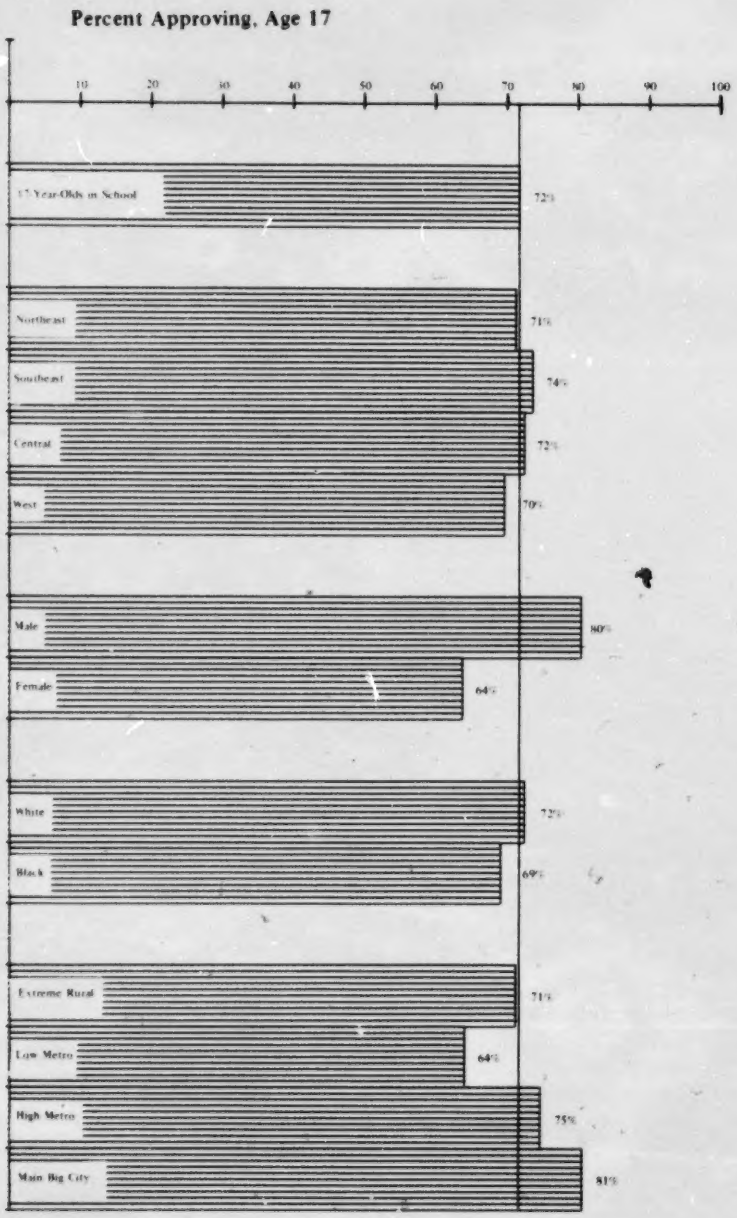


As was the case among young adults, a substantial majority of 17-year-olds attending school realized the importance of knowing the environmental impact that would occur if a new energy plant was built. The differences between adult and 17-year-old response patterns were minimal.

Percentages of Adults and 17-Year-Olds Approving Research in Atomic Energy

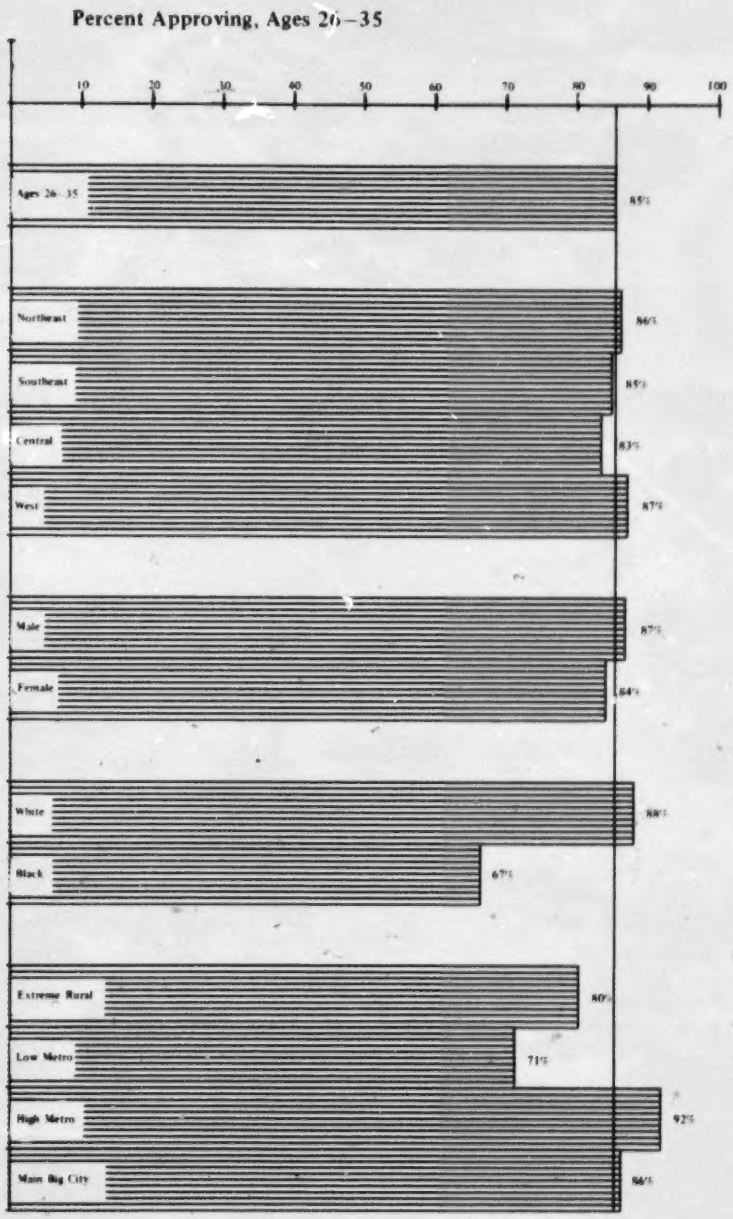


In a world of shrinking energy resources, atomic power is considered by many to be the best source of potential energy in the future. When asked in 1973 if they supported research for atomic energy, more than 80% of the adults responded affirmatively. Notable among differences in the ways various groups responded were the differences between men and women. Ninety percent of the males approved atomic research compared to 73% of the women. Black and low metropolitan adults were well below the national level of approval as well.

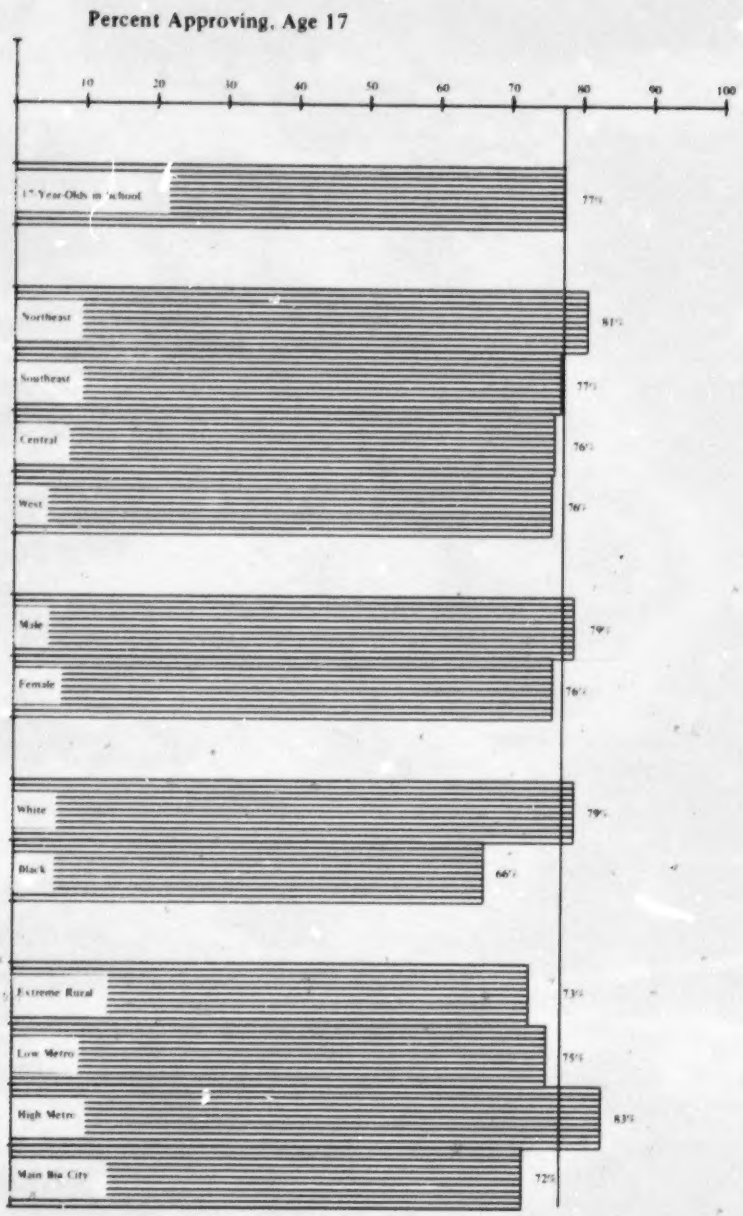


Interestingly, considerably fewer 17-year-olds attending school approved of atomic energy research than did adults when asked in 1973. About 10% fewer 17-year-olds responded affirmatively. As was the case with young adults, the percentage of men approving this type of research was well above the percentage of women. Black 17-year-olds exhibited attitudes on this issue that were similar to their peers.

Percentages of Adults and 17-Year-Olds Approving Research in Population Control

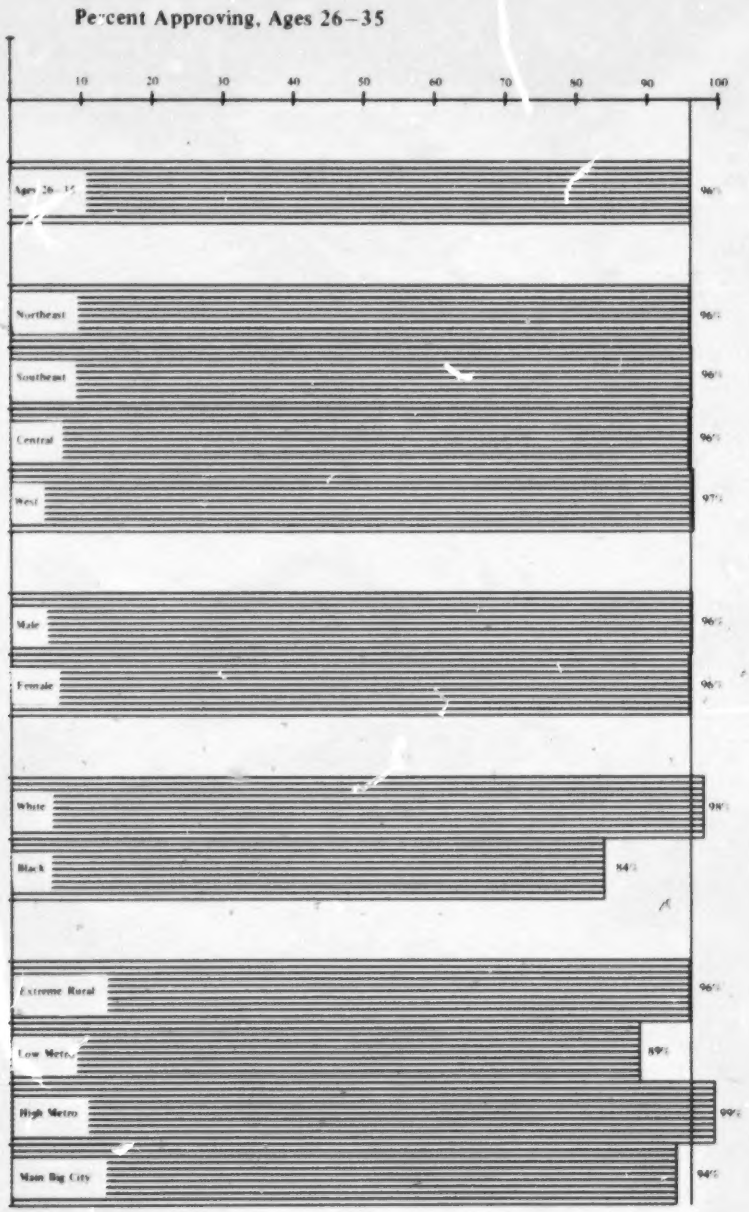


World-population pressure is integrally linked to the world's energy needs. Most young adults stated they approved of population-control research when asked that question in 1973. Most noticeable among groups in which a greater proportion of people were suspect of the concept were blacks and low metropolitan adults. But even in these groups, the majority felt research in this area should be done.

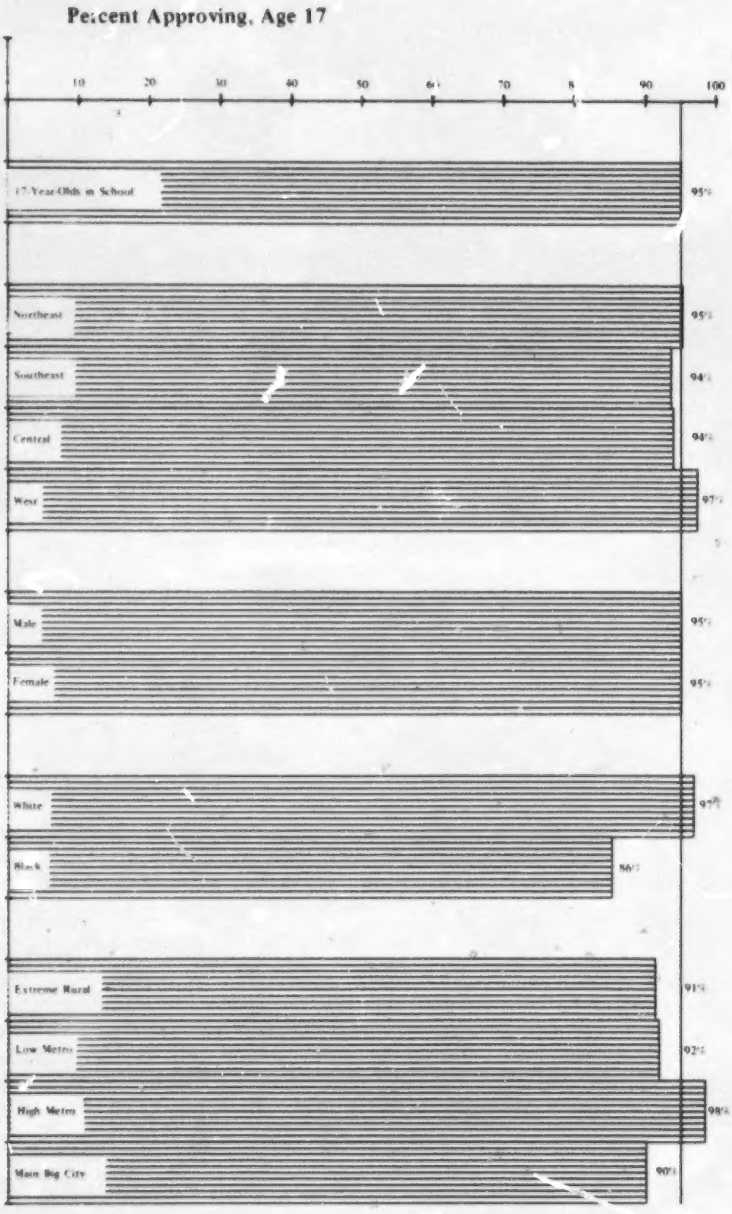


Like the young adults, 17-year-olds attending school generally approved, in 1973, research in the area of population control. About three fourths of the 17-year-olds responded affirmatively compared to more than four fifths of the young adults. As was the case with adults, black 17-year-olds were less inclined to approve population research than the other groups. The opinions of low metropolitan 17-year-olds came closer to that of their peer group in general.

Percentages of Adults and 17-Year-Olds Approving Research in Air and Water Pollution



The issues of air and water pollution cannot be separated from the larger issue of energy. In 1973, pollution was clearly a high priority in the minds of the American public. Ninety-six percent of the adults stated they approved research in this area. This represented between 10 to 15% more adults than approved research in population control or atomic energy. The percentages of approval were consistently high among the groups as well.



As was the case with young adults, the percentage of 17-year-olds attending school that approved research in air and water pollution was very high in 1973. The differences between almost all the groups and the nation was negligible.

SUGGESTIONS AND FURTHER QUESTIONS

The smattering of energy questions presented here does not provide a definitive answer to the question of whether young Americans are prepared to cope with the issue of energy. Some optimistic indications are provided. For example, almost four out of five 17-year-olds and young adults saw the need for environmental impact studies in 1973. Whether young people today are still as sensitive to environmental concerns is of current interest. A majority of young Americans approve the idea of research in pollution, population control and atomic energy. Yet differences exist in the levels of acceptance these topics received. Perhaps those differences are natural. However, they may be the result of misconceptions or misunderstandings.

Not all the questions asked by the National Assessment of Educational Progress leave room for optimism, however. For example, well under one half of the 17-year-olds or young adults knew a simple test for choosing premium or regular gasoline. Six out of 10 young Americans could not describe one. The percentage of 17-year-olds who recognize the function of a transformer dropped markedly between 1969 and 1973. In a time of rising prices and diminishing resources more people should be aware of knowledge that might be useful and practical. Is there a need for an expanded public service campaign aimed at increasing practical knowledge of energy conservation? Are present efforts working? Whose responsibility should such programs be? The school's? Industry's? Government's? Is it everyone's affair—or no one's?

Perhaps the petroleum industry and the public utilities will want to direct a larger portion of their public information campaign to increasing the practical knowledge levels of consumers. An effort in this area could be very useful. This is no time to be wasteful with energy supplies of any sort.

Government leaders and energy policymakers should keep close track of the attitudes these questions suggest. Informed policymakers need the ability both to shape public opinion and to respond sensitively to it.

Finally, we hope teachers and parent-teacher organizations will utilize these materials to measure and keep tabs upon the "Energy Quotient" of the students, school district and community. Results they collect can be compared to the national and community results National Assessment has collected. Comparisons such as these should stimulate discussion, increase understanding and clarify some issues.

* U.S. GOVERNMENT PRINTING OFFICE: 1974 — 680-077 / 162 REGION NO. 8